
NASA-13950 (MARCH 2002)
NATIONAL AERONAUTICS NASA
AND SPACE ADMINISTRATION SUPERSEDING NASA-13950
(SEPTEMBER 1999)

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SECTION 13950

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SECTION 13950

DELUGE SPRINKLER SYSTEMS
03/02

NOTE: Delete, revise, or add to the text in this
section to cover project requirements. Notes are
for designer information and will not appear in the
final project specification.

This section covers the preparation of installation
drawings and performance calculations, and the
fabrication and installation of an automatic,
heat-activated, open-head deluge type sprinkler
system.

Materials and installation should be in strict
accordance with NFPA requirements.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500 (1993; Addendum C500A - 1995) Metal Seated
Gate Valves for Water Supply Service

AWWA C651 (1999) Disinfecting Water Mains

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged

Fittings Classes 25, 125, and 250

ASME B36.10M (2000) Welded and Seamless Wrought Steel Pipe

ASTM INTERNATIONAL (ASTM)

ASTM A 135 (1993) Electric-Resistance-Welded Steel Pipe

ASTM A 53 (1999; Rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electric Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (1994) Installation of Sprinkler Systems

NFPA 24 (1992) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 409 (1990) Standard for Aircraft Hangars

NFPA 70 (2002) National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 101B (1970) Color Code For Pipelines and For Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 595 (Rev B) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 262 (1994) UL Standard for Safety Gate Valves for Fire-Protection Service

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality

control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists and Records of Existing Conditions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

The following shall be submitted for deluge automatic sprinkler systems in accordance with paragraph entitled, "General Requirements," of this section.

Connection Diagrams
Control Diagrams
Installation Drawings

SD-03 Product Data

The following shall be submitted for deluge automatic sprinkler systems in accordance with paragraph entitled, "General Requirements," of this section.

Equipment and Performance Data
Equipment Foundation Data

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Piping Materials
Aboveground Piping Systems
Valves
Detection Systems
Alarms
Air-Compressors
Sprinkler Heads
Materials
Supporting Elements

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-05 Design Data

Design Analysis and Calculations shall be submitted for deluge automatic sprinkler systems in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "Field Testing and Flushing," of this section.

Pressure Tests
System Tests
Operating Tests

SD-07 Certificates

Listing of Product Installation shall be submitted in accordance with paragraph entitled, "Scope of Work," of this section.

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Piping Materials
Aboveground Piping Systems
Valves
Detection Systems
Alarms
Air Compressor
Sprinkler Heads
Materials
Supporting Elements

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.3 GENERAL REQUIREMENTS

NOTE: If Section 15003, "General Mechanical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 15003, "General Mechanical Provisions," applies to work specified in this Section.

Connection Diagrams shall be submitted indicating the relations and connections for Piping Materials, Supporting Elements, Air Compressor, Sprinkler Heads, Valves, existing water systems and Alarms. The drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Control Diagrams shall be submitted for deluge automatic sprinkler systems showing the physical and functional relationship of equipment. Electrical diagrams shall show size, type, and capacity of the systems.

Installation Drawings shall be submitted for deluge automatic sprinkler systems showing subsurface soil conditions, and locations and elevations of existing obstructions and utilities. Drawings shall show coordination of work between different trades and with the structural and architectural elements of work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces, as well as where conflicts or clearance problems exist between various trades. Details of equipment room layout and arrangement shall also be submitted.

Material, Equipment, and Fixture Lists shall include manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Records of Existing Conditions shall be submitted showing the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

Design Analysis and Calculations shall be submitted for deluge automatic sprinkler systems including information on spray areas, hazard by class, temperature setting of heads, and hydraulic calculations.

Equipment and Performance Data shall be submitted for deluge automatic sprinkler systems including graphs and tables showing system pressures.

Equipment Foundation Data shall be submitted for deluge automatic sprinkler systems consisting of the following items:

- Equipment weight and operating loads.

- Horizontal and vertical loads.

- Size, location, and projection of anchor bolts.

- Horizontal and vertical clearances for installation, operation and maintenance.

- Plan dimensions of foundations and relative elevations.

- Installation requirements such as noise abatement, vibration isolation, and utility service.

Manufacturer's Standard Color Charts shall be submitted showing the

recommended colors and finishes.

1.4 SCOPE OF WORK

NOTE: Make selections and fill in blanks.

The work to be performed under this section includes designing and [providing new] [modifying existing] automatic [open-head] [pre-action] fire extinguishing sprinkler systems for [____ hazard occupancy] [uniform distribution of water] to afford complete fire protection coverage throughout Room [____], Building [____]. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of Volume 2 of NFPA 13, except where modified herein.

NOTE: Select design.

Each system shall be designed to withstand [earthquakes] [hurricanes].

The deluge sprinkler system shall meet the requirements for an extra-hazard system as defined in NFPA 13.

NOTE: Specify type(s) of sensing.

Each deluge valve used to supply water shall be considered a separate sprinkler system and shall be provided with an individual automatic heat-responsive system, sensing a predetermined fixed temperature, rate of rise of temperature, a combination of predetermined fixed temperature and rate of rise of temperature, infrared (6,500 to 8,500 angstroms) heat sources, or ultraviolet (1,700 to 2,900 angstroms) heat sources, as specified. Each deluge valve shall contain an approved manual release located at the valve.

Pipe sizing shall be based on hydraulic calculations to give an even distribution of water throughout the protected area.

Devices and equipment shall be makes and types listed by UL or approved by the FM laboratories and shall be from the same manufacturer.

Materials and work shall be in accordance with the required and advisory provisions of NFPA 13 and NFPA 24, unless otherwise specified. In each of the NFPA standards referred to herein, the advisory provisions are mandatory, as though the word "shall" is substituted for the word "should" wherever it appears. Reference in these standards to the authority having jurisdiction shall be interpreted to mean the Contracting Officer.

All electrical work and fire detection associated with the sprinkler system shall meet the requirements in the appropriate sections of Division 16,

"Electrical."

Listing of Product Installation shall be submitted for deluge automatic sprinkler systems showing at least 5 installed units, similar to those proposed, that have been in successful service for a minimum period of 5 years. The list shall include purchaser, address of installation, service organization, and date of installation.

PART 2 PRODUCTS

2.1 MATERIALS

NOTE: Select wording to suit project.

Materials shall conform to the applicable specifications called out in the following paragraphs.

2.2 DESIGN

Design of (pre-action) (deluge) fire extinguishing sprinkler systems shall be by [pipe schedules for [_____] hazard occupancy] [hydraulic calculations for uniform distribution of water over the design area] and shall conform to NFPA 13 and the requirements specified herein.

2.2.1 Sprinkler Heads

NOTE: Select required orifice size.

Heads shall have nominal [0.50-inch] [0.53-inch] [12.7 millimeter] [13.5 millimeter] orifice. For pre-action systems, the release element of each head shall be of the intermediate temperature rating or higher as suitable for the individual location where it is installed. For deluge systems, open heads shall be provided. For suspended ceilings, chrome-plated ceiling plates and pendant sprinklers below the ceiling shall be provided. Corrosion-resistant sprinkler heads and sprinkler-head guards shall be provided as required by NFPA 13.

2.2.2 Cabinet

Extra sprinkler heads and a sprinkler-head wrench shall be provided in a metal cabinet adjacent to the pre-action valve within each building. The number and type of extra sprinkler heads shall be as specified in NFPA 13.

2.2.3 Valves

NOTE: Select wording to suit project.

Valves shall be operated by an independent detection system. (Deluge)

(Pre-action) valve clappers shall incorporate a mechanical latching mechanism that will not be affected by changes of pressure in the water system. If 6-inch 150 millimeter valves are used in 8-inch 200 millimeter risers, smoothly tapered connections shall be provided. In addition to automatic operation, each valve shall be arranged for manual release at the valve. Gages shall be provided at the valves. A test detection device shall be provided for each actuation circuit adjacent to each valve that the device controls, as required by NFPA 13. Remote manual releases shall be provided at [_____].

2.2.4 Distribution of Water

Distribution shall be essentially uniform throughout the area in which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area shall be between 100 and 120 percent of the specified density.

2.2.5 Density of Application of Water

NOTE: Select wording to suit project.

Pipe shall be sized to provide the specified density when the system is discharging the specified maximum required flow. Application to horizontal surfaces below the sprinklers shall be [_____] gallons per minute (gpm) per square foot liter per minute (lpm) per square meter with outside hose stream requirements of [_____] gpm. lpm.

2.2.6 Sprinkler Discharge Area

NOTE: Select either of the following two paragraphs.
Insert area dimensions.

Area shall be the hydraulically most remote [_____]-square foot meter area as defined in NFPA 13.

Area shall be as indicated based on the [_____] foot meter radius rule and shall conform to NFPA 409 for aircraft hangars.

2.2.7 Friction Losses

Losses in pipe shall be calculated in accordance with the Hazen-Williams formula with a C-value of 120 for deluge, and C-values of 100 for pre-action for steel pipe, 150 for copper tube, and 140 for cement-lined, ductile, iron pipe and non-asbestos cement pipe.

2.2.8 Location of Sprinkler Heads

The spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for ordinary hazard occupancy, except that for a discharge density of more than 0.20 gpm per square foot 8.1 liter per minute per square meter, the

spacing of the sprinkler heads shall not exceed that for extra hazard occupancy. The spacing of sprinklers on the branch lines shall be essentially uniform.

2.2.9 Water Supply

NOTE: Select wording to suit project.

Hydraulic calculations shall be based on a static pressure of [_____] pounds per square inch, gage (psig) kilopascal, gage with [_____] gpm lpm being available at a residual pressure of [_____] psig kilopascal at the [point indicated] [junction with the distribution system].

2.3 DETECTION SYSTEMS

NOTE: Select wording to suit project.

Detection system shall be [pneumatic] [hydraulic] [electric] [heat detectors] [smoke detectors]. The nondetecting connecting (piping) (tubing) (wiring) shall be supervised circuits. Tubing and wiring shall be installed in protective (material) (metal) conduit or tubing.

2.3.1 Spot Heat Detection Units

NOTE: Select wording to suit project.

Units shall be provided for [surface] [flush] outlet box mounting. Units shall be supported independently of conduit, tubing, or wiring connections. Units shall be completely metal enclosed and shall be [combination fixed temperature and rate-of-rise] [fixed temperature and rate-compensated] [infrared] [ultraviolet] [_____] type. Contacts shall be self-resetting after (response to rate-of-rise) actuation. Operation under fixed temperature actuation shall result in an indication that may be noted by external visual inspection of the unit or the unit may be of the self-resetting type. At least two units shall be provided in spaces over 600 square feet 55.7 square meter. Fixed temperature type units shall be provided in areas subject to abnormal temperature changes, such as showers and boiler rooms. Units located in areas subject to moisture or exterior atmospheric conditions shall be types approved for such locations. Removal of any unit from the system shall result in the actuation of a trouble signal. Not less than two extra detection devices of each type for each system shall be provided. A portable electric device suitable for testing the detectors shall be furnished.

2.3.2 Smoke Detection Units

NOTE: Select wording to suit project.

Detection of abnormal smoke densities shall be provided by the (ionization principle) (photoelectric principle) (cloud-chamber principle). Control and power panels required shall be provided either as individual units or integral with the main control panel. Detectors and associated panels that are compatible with the main control panel and suitable for use in a supervised circuit shall be provided. Malfunction of the electrical circuitry to the detector or its control or power units shall result in the operation of the system trouble devices. Each detector shall contain a visible indicator lamp that shall show when the unit is activated. Each detector shall be the plug-in type in which the detector base contains screw terminals for making wiring connections. Detector spacing and location shall be in accordance with the manufacturer's recommendation. A remote indicator lamp shall be provided for each detector that is located above suspended ceilings, beneath raised floors, or otherwise concealed from view.

2.3.2.1 Ionization Detectors

Multiple chamber type ionization detectors responsive to both invisible and visible products of combustion shall be provided. Detectors shall not be susceptible to operation due to changes in relative humidity. The sensitivity of each detector shall be field-adjustable to compensate for the conditions under which it is to operate. Detectors shall be the two-wire type.

2.3.2.2 Photoelectric Detectors

Detectors provided shall operate on a multiple cell concept using a light-emitting diode (LED) light source. Failure of the LED shall not cause an alarm condition but shall operate the detector indicating lamp.

2.3.2.3 Cloud Chamber Detectors

A UL-listed FM-approved detector measuring particles in the 0.0025 to 0.01 micrometer range shall be provided through a sampling mechanism. Failure of the sampling mechanism shall cause a trouble signal.

2.3.3 Control Panel

NOTE: Select wording to suit project.

A modular type control panel for electrically operated detection systems shall be provided and installed in a surface-mounted steel cabinet with hinged doors and cylinder lock. The control panel shall be a neat, compact, factory-wired assembly containing all parts and equipment required to provide all specified operating and supervisory functions of the system. Batteries shall be located in a steel, lockable cabinet. The cabinet shall be enamel-finished on the inside and the outside, with prominent rigid plastic or metal identification plates attached. Trouble lights shall be located on doors of cabinets; a trouble alarm shall be located above top of

cabinet. System power shall be 120-volt, 60-hertz service, transformed through a two-winding isolation transformer and rectified to low voltage dc for operation of all system actuating, signal sounding, trouble signal, and fire alarm tripping circuits. Electric detection system shall be electrically supervised against opens on all circuits. A ground fault condition that prevents the required operation of the system or a single break in any of the actuation system circuits shall result in the activation of a [4-inch] [100 millimeter] system trouble bell [_____]. Loss of ac power shall result in operation of the system trouble alarm. Trouble alarm shall sound continuously until the system has been restored to normal or trouble silencing switch has been operated. A silencing switch that transfers trouble signals to an indicating lamp shall be provided so that correction of the trouble condition will automatically transfer trouble signal from indicating lamp back to trouble alarm until the silencing switch is restored to normal position. Electrical control panels, batteries, and battery charger for electrically actuated systems shall be weatherproof type or located in areas not subject to water damage.

2.3.4 Secondary Power Supply

A battery charger and the specified quantity of nickel-cadmium, lead-calcium, or sealed lead-acid, rechargeable storage batteries shall be provided.

2.3.4.1 Battery Charger

Charger shall provide completely automatic high and low charging rate and shall be capable of recovery of the batteries from full discharge to full charge in 24 hours or less. An ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge shall be provided. If a high-rate switch is provided, a red pilot light shall be provided as part of the unit assembly to indicate when batteries are manually placed on a high rate of charge.

2.3.4.2 Storage Batteries

Batteries of the proper ampere-hour rating shall be provided to operate the system and provide supervision for up to 60 hours. Calculations shall be submitted that substantiate the battery capacity. Reliable separation between cells shall be provided to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.3.5 Wiring

Alternating current (ac) operating power for control panel, battery charger, and air compressor shall be obtained, ahead of all building services, from the line side of the incoming facility power source. Independent properly fused safety switches shall be provided, with provisions for locking the covers and operating handles in the POWER ON position for these connections. The switches shall be located adjacent to the main distribution panel. The switch boxes shall be painted red and identified by a permanent lettered designation. Wiring with color code shall be provided in accordance with NFPA 70. Wire for 120-volt circuits shall be No. 12 AWG minimum. Wire for low-voltage dc circuits shall be No.

14 AWG, minimum. Wiring shall be provided in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, as specified.

2.3.6 Conductor Identification

Circuit conductors within each enclosure where a tap, splice, or termination is made shall be identified. Conductor shall be identified by plastic-coated, self-sticking, printed markers or by heat-shrink-type sleeves. The markers shall be attached in a manner that will preclude accidental detachment. The control circuit terminations shall be identified.

2.3.7 Supervision

NOTE: Select wording to suit project.

[Pre-action sprinkler piping] [Pneumatic detection system] shall be supervised. A break in the piping or tubing systems resulting in loss of pneumatic pressure shall result in the activation of a trouble alarm. A silencing switch shall be provided and arranged to transfer trouble signals to an indicating lamp and ensure that correction of the trouble condition will automatically transfer the trouble signal from the indicating lamp back to the trouble alarm until the silencing switch is restored to normal position.

2.4 ALARMS

2.4.1 Water Motor Alarm

Alarms of the approved weatherproof and guarded type shall be provided. Each alarm shall sound locally upon flow of water in the sprinkler system to which it is connected. Alarms shall be mounted on the outside of the outer walls of each building, at a location as directed.

2.4.2 Local Alarm

An electric alarm horn or bell, as specified, shall be provided to sound locally on operation of any detection system, regardless of whether water flows or not. The current for these alarms shall be taken from the facility service where connection is made ahead of all other services.

2.4.3 Fire Alarm

Equipment for the automatic transmittal of an alarm over the facility fire alarm system shall be provided and arranged to actuate by detection system and by the flow of water in each sprinkler system. Class A supervision of detection and actuation circuits shall be provided.

2.4.4 Trouble Alarm

NOTE: Select wording to suit project.

A local [4-inch] [100 millimeter] electric alarm [bell] [horn] [_____] shall be provided to indicate trouble or failure of the detection system air compressor, including abnormal low-pressure conditions [pre-action sprinkler piping system].

2.5 TANK-MOUNTED AIR COMPRESSOR

NOTE: Select tank capacity.

An approved automatic type electric-motor-driven air compressor including pressure switch, air piping and a [_____] [10]-gallon [38]-liter minimum capacity tank shall be provided. The compressor shall have a minimum capacity capable of charging the complete sprinkler system to normal system air pressure within 30 minutes and within 15 minutes for the pneumatic detection system. Each system shall be provided with an approved automatic air maintenance device.

2.6 ABOVEGROUND PIPING SYSTEMS

Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made through standard tapered reducing pipe fittings; the use of bushings will not be permitted. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or graphite and oil, applied only on male threads. Pipe nipples 6 inches 150 millimeter long and shorter shall be Schedule 80 steel pipe. The piping shall be concealed in areas with suspended ceilings.

2.6.1 Water Pipe

Pipe shall be carbon steel. All piping shall be suitable for a working pressure of not less than 175 psig, 1207 kilopascal gage, in accordance with ASME B36.10M or ASTM A 135.

2.6.2 Sprinkler Pipe and Fittings

Sprinkler pipe and fittings shall meet NFPA 13, except that steel piping shall be Schedule 10 for sizes smaller than 8 inches 200 millimeter and Schedule 30 for sizes 8 inches 200 millimeter and larger. Water motor alarm piping shall be zinc-coated steel pipe and fittings. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted only in pipe size 4 inches 100 millimeter and larger. Rubber gaskets for use in dry pipe sprinkler system shall be UL listed. Restriction orifices, reducing flanges, and plain-end fittings with mechanical couplings that use steel gripping devices to bite into the pipe when pressure is applied shall not be used.

2.6.3 Double Basket Strainers

When specified, double gasket strainers with removable screens having

standard perforations 0.125 inch 3 millimeter in diameter shall be provided in the riser beneath the deluge valves.

2.6.4 Pipe Hangers and Supports

Pipe hangers and supports shall be provided in accordance with NFPA 13 and shall be black iron.

2.6.5 Valves

NOTE: Select valve type.

Valves shall be provided as required by NFPA 13 and of types approved for fire service. Gate valves shall open by counterclockwise rotation. Check valves shall be flanged, clear opening, swing check type with flanged inspection and access cover plate for sizes 4 inches 100 millimeter or larger. An outside screw and yoke (OS&Y) valve shall be provided beneath each [deluge] [pre-action] valve in each riser when more than one valve is supplied from the same water supply pipe.

Sprinkler system valves shall be equipped with electrical supervision devices, connected to the building fire alarm system, indicating the open or closed position of the valve or any trouble condition. The devices shall meet requirements of Division 16, "Electrical."

2.6.6 Identification Signs

Properly lettered approved metal signs conforming to NFPA 13 shall be attached to each valve and alarm device. Design data identification plates shall be permanently affixed to the riser of each system.

2.6.7 Inspector's Test Connection

Test connections shall be provided about 6 feet 1830 millimeter above the floor for each sprinkler system, located at the most hydraulically remote part of each system. Test connection piping shall be provided to a location where the discharge will be readily visible and where water may be discharged without damage.

2.6.8 Main Drains

Drain piping shall be provided to discharge at safe points outside the building or to sight cones attached to drains of adequate size to readily receive the full flow from the drain under maximum pressure. Auxiliary drains shall be provided as required by NFPA 13.

2.6.9 Pipe Sleeves

Pipe sleeves shall be provided where piping passes through walls, floors, roofs, and partitions. Sleeves shall be secured in proper position and location during construction. Sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions shall be provided.

Not less than a 0.25-inch 6.0 millimeter space between exterior of piping or pipe insulation and interior of sleeve shall be provided. Space shall be firmly packed with insulation and calked at both ends of the sleeve with plastic waterproof cement.

2.6.9.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53, Schedule 40 or standard weight, zinc-coated steel pipe sleeves shall be provided in masonry and concrete walls, floors, and roofs as required. Sleeves in floor slabs shall extend 3 inches 75 millimeter above the finished floor.

2.6.9.2 Sleeves in Partitions and Other Locations

Zinc-coated steel-sheet sleeves having a nominal weight of not less than 0.90 pound per square inch 0.633 gram per square millimeter shall be provided in other than masonry and concrete partitions and walls, floors, and roofs.

2.6.10 Escutcheons

Approved one-piece or split-hinge-type escutcheons shall be provided for piping passing through floors, walls, and ceilings in both exposed and concealed areas. Chrome-plated metal escutcheons shall be provided where pipe passes through finished ceilings. Other escutcheons of steel or cast iron with aluminum paint finish shall be provided where indicated. Escutcheons shall be securely anchored in place with setscrews or other approved positive means.

2.6.11 Fire Department Inlet Connections

Inlet connections, about 3 feet 915 millimeter above grade, of the approved two-way type with 2.5-inch 65 millimeter National Standard female hose threads with plug and chain shall be provided.

2.6.12 Joints

Joints shall be threaded or flanged; welded joints are not acceptable.

2.7 BURIED PIPING SYSTEMS

2.7.1 Pipe and Fittings

NOTE: Select cover depth.

Outside-coated cement-lined ductile iron pipe and fittings conforming to NFPA 24 shall be provided for piping under the building and less than 5 feet 1525 millimeter outside the building walls. Joints shall be anchored in accordance with NFPA 24, using pipe clamps and steel rods. Minimum pipe size shall be 6 inches 150 millimeter. Minimum depth of cover shall be [_____] [3] feet [915] millimeter. Piping more than 5 feet 1525 millimeter outside the building walls shall be outside-coated, cement-lined, ductile,

iron pipe and fittings conforming to NFPA 24 and provided under Section 02515, "Water Systems."

2.7.2 Valves

Valves shall be provided as required by NFPA 24 for fire service. Gate valves shall conform to AWWA C500 or UL 262 with cast iron body and bronze trim, and shall open by counterclockwise rotation.

2.7.3 Post Indicator Valve Assembly (PIV)

Assembly shall consist of a standard FM-approved or UL-listed inside-screw gate valve with an above-grade post indicator or a completely factory-assembled FM-approved quarter-turn valve and above-grade post indicator-operator. Direction to open shall be counterclockwise.

Quarter-turn valve shall be a wafer-type butterfly valve, rated at 175 psi 1207 kilopascal, elastomer-lined and sealed. Liner shall act as a gasket between ASME B16.1, Class 125 or Class 250 flanges. Post shall have a fail-safe feature to keep valve intact in case of breaking off above grade.

Operator shall be worm-gear type with permanently oil-lubricated watertight gear case complete with handle.

Surfaces below grade shall receive a coating of bitumen not less than 20 mils 0.51 millimeter thick. Above-grade surfaces shall be filled, primed and finished with a multiple coat of high-gloss, weather-resistant, red enamel.

Post indicator valves shall be fitted to accommodate electrical supervisory switches.

Electrical supervisory switches shall be provided for interconnection to the building fire alarm system. Switches and connections shall meet the requirements of Section 13852, "Fire-Alarm Systems."

2.7.4 Valve Boxes

Except where indicator posts are provided, each gate valve in buried piping shall be provided with an adjustable cast-iron valve box of a size suitable for the valve on which it is to be used. Boxes outside of paved areas may be of acrylonitrile-butadiene-styrene (ABS) plastic or of inorganic fiber reinforced black polyolefin plastic. The head shall be round and the lid shall have the word WATER cast on it. The least diameter of the shaft of the box shall be 5.25 inches. 133 millimeter. Each cast-iron box shall be provided with a heavy coat of bituminous paint.

2.8 VALVE SIGNS

Properly lettered approved metal signs shall be attached to each control valve.

2.9 MODIFICATIONS TO EXISTING POST INDICATOR VALVES

NOTE: Delete or modify this part as required.

The Contractor shall modify existing post indicator valves by furnishing and installing a double-pole double-throw limit switch on each valve. The limit switch shall be enclosed in a NEMA 250, Type 4, enclosure and shall be rated 15 amperes at 115 volts ac. The limit switch shall be installed to actuate when the valve starts to close and when the valve is fully open.

Wiring for these switches shall be extended to the existing fire-alarm panel and shall be installed in conduit.

2.10 MOTORS

NOTE: Delete if air compressor is not required.

Motors less than 3/4 horsepower 560 watts shall be Type TEFC, single-phase, 115-volt, 60-hertz, capacitor start.

Motors over 3/4 horsepower 560 watts shall be Type TEFC, three-phase, 208-volt, 60-hertz, normal torque.

Motors used on air-compressors shall be close-coupled to the compressors.

PART 3 EXECUTION

The deluge sprinkler system shall be provided with complete drainage facilities in accordance with the applicable requirements of NFPA 13.

3.1 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Tapping or drilling machine valve and mechanical joint type sleeves shall be used for connections to be made under pressure. Sleeves shall be bolted around the mains and the valve conforming to AWWA C500 shall be bolted to the branch. The valve shall be opened, drilling machine attached, tap made, valve closed, and drilling machine removed, all without interruption of service. The Contracting Officer shall be notified in writing at least 15 days prior to the date the connections are required; approval shall be received before any service is interrupted. Material required to make connections into the existing water supply system shall be furnished and excavating, backfilling, and other incidental labor performed as required.

NOTE: Add any government-furnished assistance.

The [Contractor shall furnish] [Government will furnish only] the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.2 DISINFECTION

New water piping and existing water piping affected by the Contractor's operation shall be disinfected in accordance with AWWA C651. Piping systems shall be filled with a solution containing a minimum of 50 parts per million (ppm) of available chlorine and the solution allowed to stand for a minimum of 24 hours. The solution shall be flushed from the system with clean water until maximum residual chlorine content is not greater than 0.2 ppm. The Government will supply the water but the Contractor shall be responsible for approved disposal of contaminated water.

3.3 PAINTING

NOTE: Coordinate with painting section.

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Government.

Pipe, pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All exposed piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles and Siamese connections, shall receive one coat of enamel, Color No. 11105 (red) in accordance with MIL-STD 101B and FED-STD 595.

3.4 ELECTRICAL WORK

Electrical work is specified in Division 16, "Electrical," except as noted.

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment, except that controllers indicated as part of the motor control centers shall be provided under Section 16345, "Motor Control." Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16145, "Standard Wiring Systems." Controllers and contactors shall have maximum 120-volt control circuits and auxiliary contacts for use with the controls furnished. When motors and equipment are furnished larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

3.5 FIELD TESTING AND FLUSHING

Test reports required for new work shall be performed by the Contractor. When the Contracting Officer desires to be present during testing, the Contractor shall notify the Contracting Officer 48 hours in advance of the start of testing.

Test reports shall be submitted for Pressure Tests, System Tests and Operating Tests.

3.5.1 Flushing of Underground Connections

Underground mains and lead-in connections to system riser shall be flushed before connection is made to sprinkler piping to remove foreign materials that may have entered the underground during the course of the installation. The flushing operation shall be continued until water is clear.

Underground mains and lead-in connections shall be flushed at a flow rate not less than indicated below or at the hydraulically calculated water demand rate of the system, whichever is greater.

<u>Pipe Size</u> <u>(inches)</u>	<u>Flow Rate</u> <u>(gpm)</u>	<u>Pipe Size</u> <u>(millimeter)</u>	<u>Flow Rate</u> <u>(lpm)</u>
4	400	100	1512
5	600	125	2268
6	750	150	2835
8	1,000	200	3780
10	1,500	250	5670
12	2,000	300	7560

3.5.2 Preliminary Tests

NOTE: Select water pressure.

Each system shall be hydrostatically tested at [_____] [200] psig [1380] kilopascal for a period of 2 hours and flushed in accordance with NFPA 13. Piping above suspended ceilings shall be inspected, tested, and approved before installation of ceilings. The alarms and other devices shall be tested. The water flow alarms shall be tested by flowing water through the inspector's test connection. When tests have been completed and all corrections made, a signed and dated certificate, similar to that specified in NFPA 13, shall be submitted with a request for formal inspection and tests.

3.5.3 Formal Inspection and Tests

The Contracting Officer will witness formal tests and approve all systems before they are accepted. The request for formal inspection shall be submitted at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the Contractor shall be present during the inspection. At this inspection, any or all of the required tests shall be repeated as directed. Each detection device and its connection to each valve shall be tested by the application of heat. Each deluge system shall be tested by full flow from the individual

system or any combination of systems. Defects in the work provided by the Contractor shall be corrected, and additional tests shall be made until it has been demonstrated that the systems comply with all contract requirements. Appliances, equipment, electricity, instruments, connecting devices, and personnel for the tests shall be furnished by the Contractor. The Government will furnish the water for the tests.

3.5.4 Disposition of Test Water

The Contractor shall obtain approval of the plan for the disposal of water issuing from test outlets to avoid property damage.

3.5.5 Test Point

The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.

3.5.6 Leakage

The inside sprinkler piping shall be installed so that there will be no visible leakage when the system is subjected to the hydrostatic Pressure Tests.

3.5.7 Piping Test

Piping between the check valve in the fire department inlet piping and the outside connection shall be tested the same as the balance of the systems.

3.5.8 Test Blanks

Test blanks, if used, shall be of the self-indicating type. Test blanks shall have red painted lugs protruding beyond the flange in a way to clearly indicate their presence. Test blanks shall be numbered to enable tracking their use and location and to ensure their removal after the test is completed.

3.6 OPERATION AND MAINTENANCE

The Contractor shall submit [6] [_____] copies of the Operation and Maintenance Manuals 30 days prior to testing the deluge automatic sprinkler systems. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Test data shall be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals shall have 3/8-inch 10 millimeter holes and be bound in 3-ring, loose-leaf binders. Data shall be organized by separate index and tabbed sheets, in a loose-leaf binder. The binder shall lie flat with printed sheets that are easy to read. Caution and warning indications shall be clearly labeled.

The Contractor shall provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. These services shall be directed by the Contractor, using the manufacturer's factory trained personnel or qualified representative. The Contracting Officer shall be given seven days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor; e.g., lists, static exhibits, visual aids, shall be made available to the Contracting Officer.

-- End of Section --